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A WELL-TILLED, WELL-PRUNED ORCHARD.

Pruning of Tree and Bush Fruits.

OCTOBER, 1903.

LOGAN, UTAH

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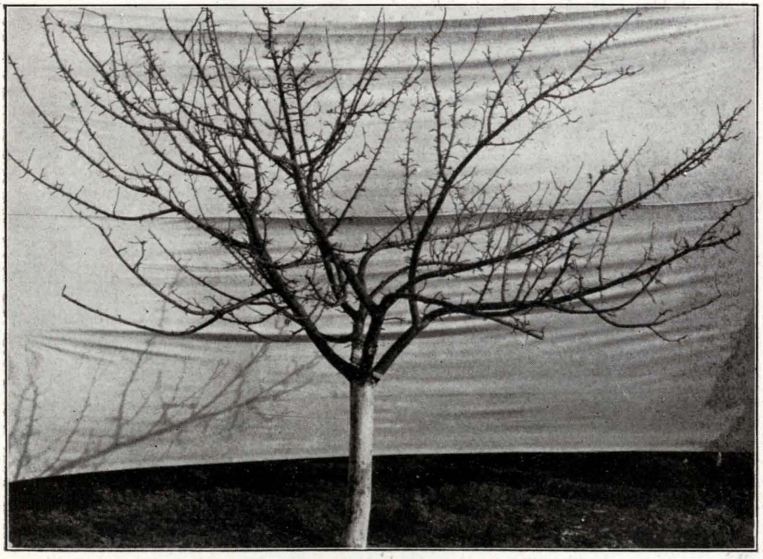


Fig. 1. A productive tree.

Fig. 2. A tree showing too much wood growth.

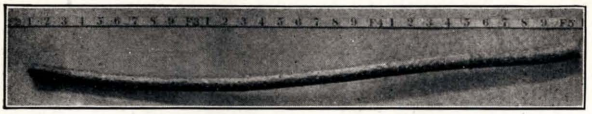


Fig. 3. A branch showing natural pruning.

Fig. 4. Cross-section of tree trunk.

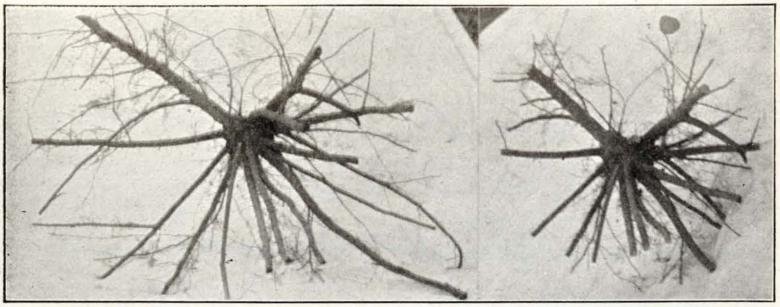


Fig. 5. Roots before pruning for transplanting.

Fig. 6. Roots after pruning for transplanting.

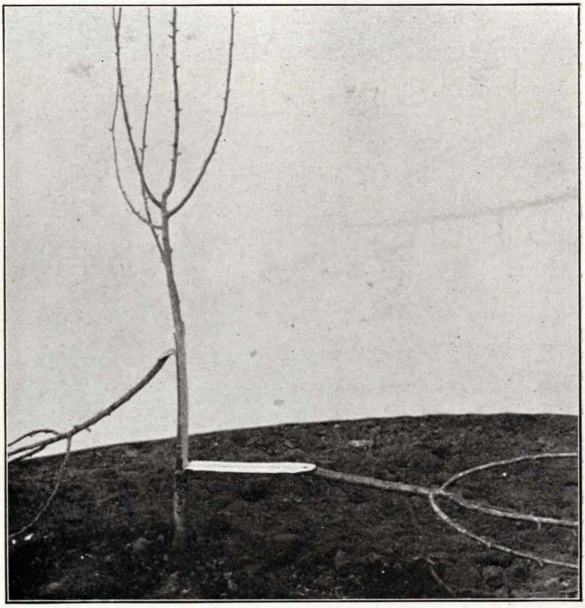
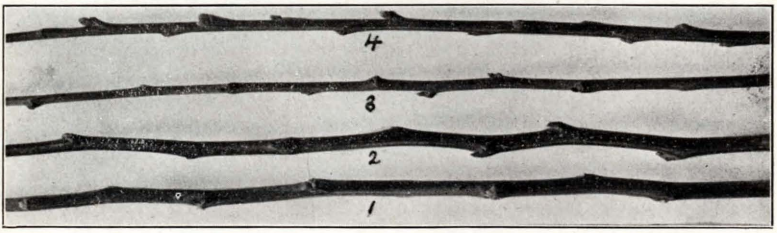


Fig. 7. The result of opposite crotches.



Figs. 8 and 9. The arrangement of buds.

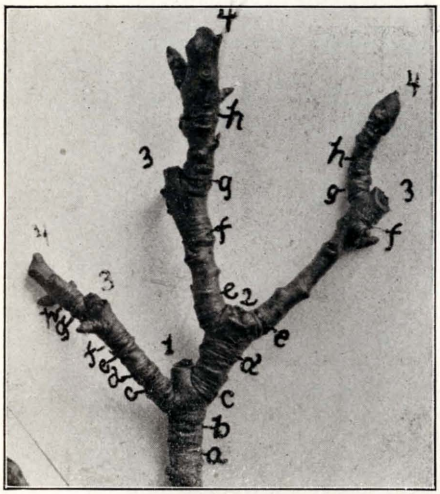


Fig. 10. The life history of a twig.

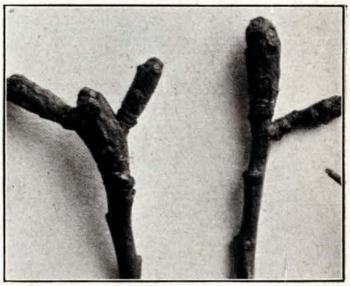


Fig. 11. Enlarged twigs.

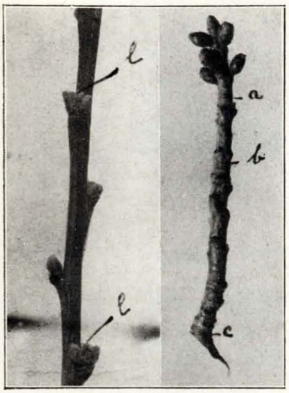


Fig. 12. Fig. 13.

Fig. 14.

Fig. 12. The fruit and leaf buds of the peach.
Fig. 13. The fruit and leaf buds of the cherry.
Fig. 14. The fruit and leaf buds of the plum.

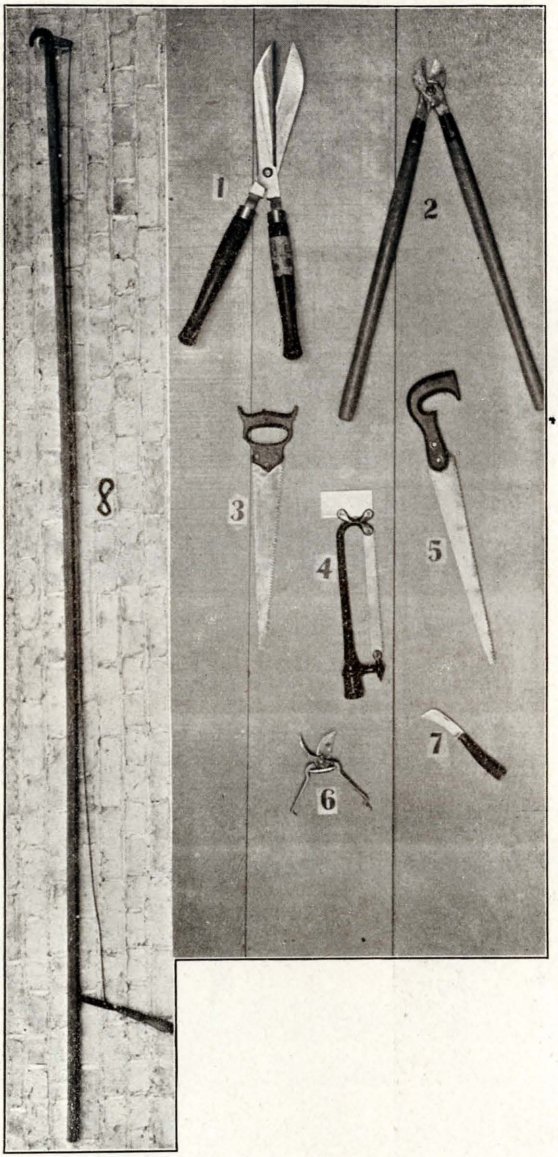


Fig. 15. Pruning tools.

Fig. 16. Aged peach tree one year after heading back.

Fig. 17. The same tree properly pruned after heading back.

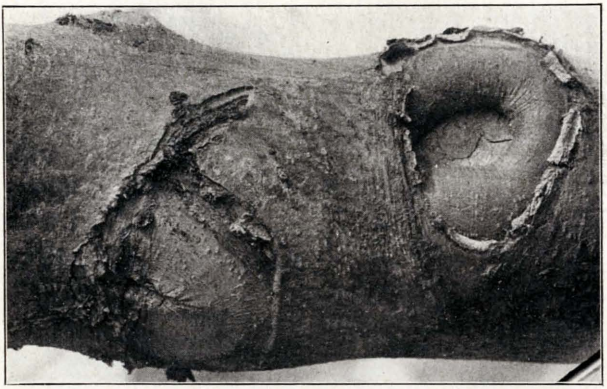


Fig. 18. The result of properly made cuts

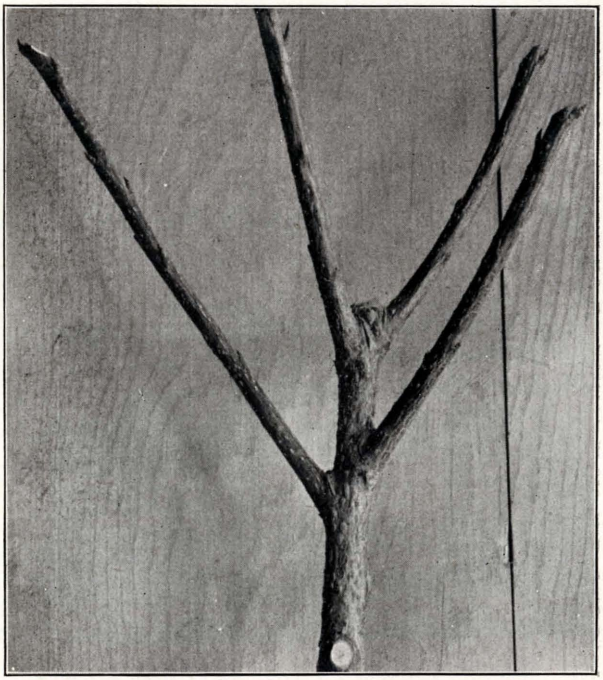


Fig. 19. Head of tree correctly started.

Fig. 20. A neglected tree.

Fig. 21. Old peach tree ready for heading down.

Fig. 22. Red raspberries before pruning.

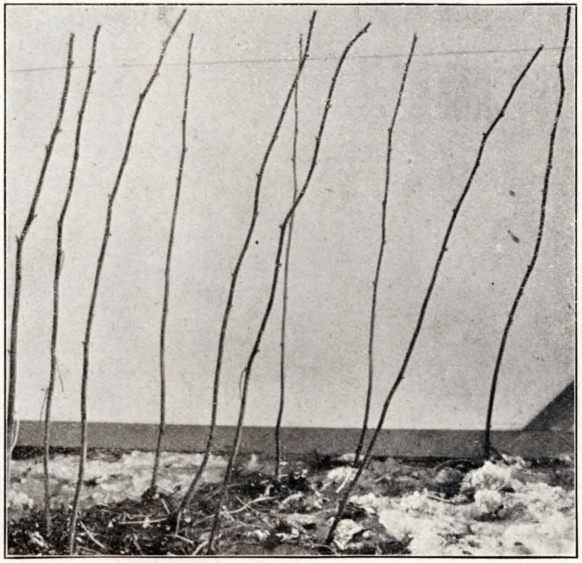


Fig. 23. Red raspberries after pruning.

Fig. 24. Currant bush before pruning.

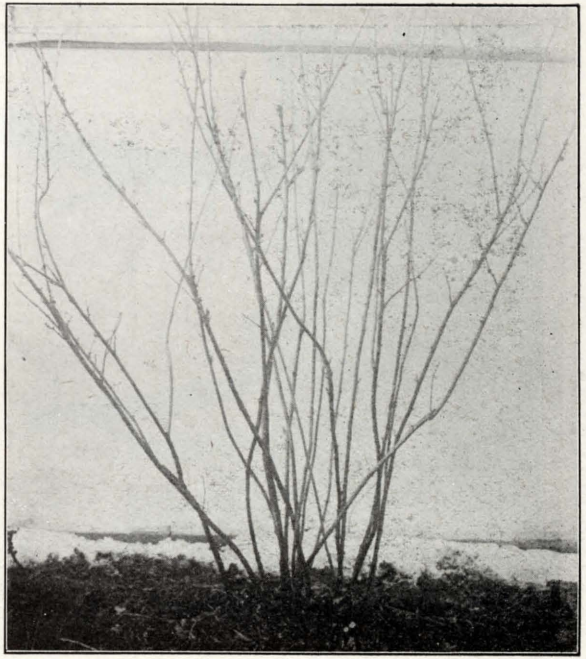


Fig. 25. Same bush after pruning.

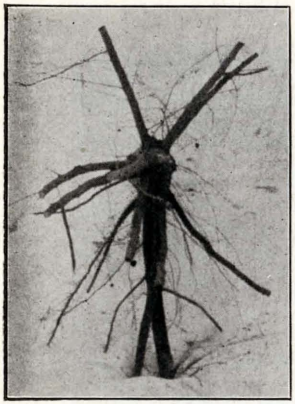


Fig. 26. Brace-roots.

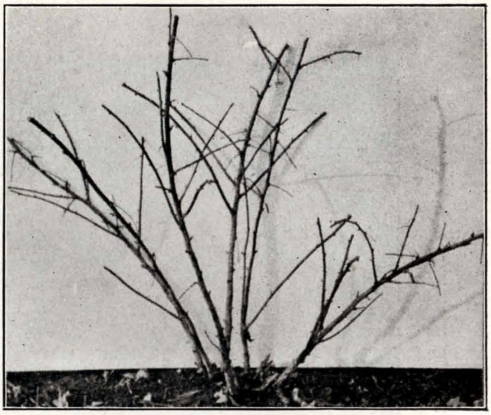


Fig. 27. Properly pruned bush of black raspberries.

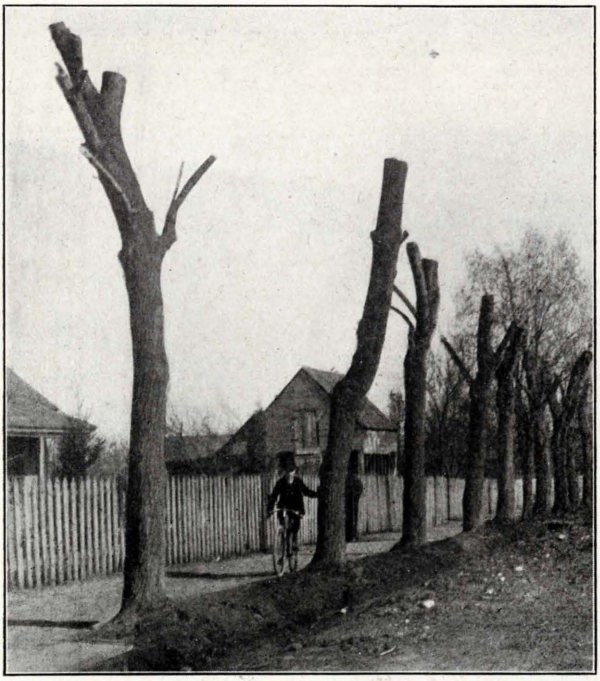


Fig. 28. Murderous pruning of shade trees.

CONTENTS.

PREFACE.

This bulletin is prepared with the idea of giving directions for the pruning of the ordinary orchard and garden fruits. The underlying principles of plant growth have been somewhat fully explained so that the man behind the saw and shears may be able to give intelligent and merciful pruning.

I wish to acknowledge the very valuable work of Mr. James Dryden, Station photographer, in taking scores of photographs from which the illustrations of this bulletin were selected. Cuts 10, 11 and 20 were kindly loaned by Mr. G. C. Creelman of the Department of Agriculture, Toronto, Canada.

W. N. HUTT,
Horticulturist.

PRUNING OF TREE AND BUSH FRUITS.

W. N. HUTT.

INTRODUCTION.

"How shall we prune" is a question probably more frequently asked than any other in the whole range of horticulture. To answer it brings forth a second question, viz., "Why do we prune?" Pruning is a means to an end. So then to prune intelligently and therefore successfully, there should be in the mind of the operator some definite purpose. Too often pruning is simply a cutting of the tree without any idea as to the final purpose such cutting is to serve. Such pruning invariably does harm instead of good, and has ruined countless trees. Since the ultimate purpose of a shade tree is different from that of a fruit tree it is evident that it should receive different treatment. A tree grown for wood or timber should be managed still differently from either. Again, a fruit tree bearing on one-year-old wood must not be pruned the same as that bearing on two-year-old wood. Upright-growing varieties require to be trained on a different plan from those of spreading or drooping habit. The nature of the pruning any tree should receive will depend, therefore, on the purpose for which the tree is grown, on its variety, and also on its habit of growth. In short, to prune intelligently we must understand trees.

Natural Pruning.—Trees, under natural conditions, are constantly being pruned. Every autumn nature strips the trees of their leaves: this is their regular annual prnning. Frost and wind assist in this pruning but there is a definite process in the ripening of the bark, by means of which the leaves are cast off. Besides this there is a continual pruning of buds and branches. If every bud which a tree produced came to maturity, that is produced a branch, the tree would become a veritable brush pile. But the buds most

favorably situated as regards light get the most nourishment, and the shaded ones become starved and finally die and drop off. Figure 3 showing part of a four-year-old sucker from a wild cherry tree is an extreme example of the natural pruning of buds. This sucker has been so shaded that for three feet of its length it has not produced a single branch. Most of the buds have disappeared altogether, leaving scarcely a scar to mark where they once were. In like manner the lower limbs of trees, and those within the crown where the leaves do not get much sunlight, become weakened and die. Then the wind, nature's pruning hook, comes along and removes the dead branch. Any vigorous tree affords examples of nature's handiwork in this line. It is this principle in the crowding and shading of side branches, that causes forests to produce long, clear, straight timber. In this way trees are constantly ridding themselves of useless branches and the pruning so effected is undoubtedly a benefit to the branches that remain. For the dividing of the food material among a less number of members tends towards the greater development of each and the consequent general improvement of the tree.

Artificial Pruning.—So then nature prunes and even her more or less irregular methods are beneficial. In a greater degree then would exact and careful methods of pruning tend towards the tree's best development. Fruit trees are however in a highly specialized condition. Our large, beautiful, luscious fruits of today stand in very striking contrast to the wild fruits from which they have been produced. By selection, cultivation and fertilization they have been raised from their natural condition and to be maintained in this highly specialized condition they must receive special treatment. If we cease our attentions for a few years the fruit becomes small and loses its fine color and flavor; in short, it begins to revert towards its wild parent. An unpruned orchard is a too common example of this fact. Pruning is essential to trees if they are to be kept up to their standard of productiveness and of fine quality of fruit. The fruit tree is, in a sense, a machine for producing fruit, and intelligent pruning is one of the means by which it can be made to manufacture the most fruit of the best quality, in the shortest time, and to keep up the output for the long-

est possible period. A correct understanding, therefore, of this machine and all its working parts is necessary to the most successful manipulation.

STRUCTURE OF THE TREE.

If the trunk of a tree or a large-sized branch or root be cut through it will appear as in Figure 4. On the outside will be seem the bark; next inside of it the light-colored portion or sap-wood; while the darker central portion is the heart-wood. Just between the bark and the sap-wood, if we could see it, is a layer of very delicate tissue known as the cambium.

Cambium.—The cambium can best be seen by removing the bark on some actively growing tree, and so sensitive is it that exposure to the air will kill it in a few minutes. It appears as a soft, doughy or slimy substance that can be scraped off with the thumb-nail. If some of this doughy substance be taken off carefully and examined under a microscope, it will be seen to be made up of countless little cells, each with a delicate wall about it and containing a thickish liquid. The cells are brick-shaped, are placed end to end and built layer on layer like bricks in a building. The substance of the cells is very delicate, is easily affected by drying, frost or wet and may be easily crushed or torn. It is the giving way of the cambium cells that causes the bark to strip off from the wood. At the first removal of the bark the cambium is white but in a few minutes it has turned dark brown which shows that it is dead. As the bark covers the wood from the smallest root-tip to the terminal bud, so the cambium of the trunk is continuous with that of the root and forms a complete layer over the entire wood of the tree. During the growing season the cambium cells divide lengthways forming new cells. These again divide and grow and new cells are formed till by fall there is formed on the inside of the cambium a new ring of wood and on its outside a new ring of bark. A few rows of the cambium cells are left to carry on the growth for the next year. The cambium is thus the only tissue of the tree that retains the power of active growth from year to year. By it the annual rings of bark and wood are formed and also the new growth that heals over wounds.

The Bark.—In bark, nature has formed for the delicate cambium a perfect protective covering. Like the cambium the bark is composed of cells, as in fact are all vegetable and animal structures. But the cells of the bark have thick walls of a tough corky substance, and each cell contains air instead of liquid. The corkiness of the bark makes it an impervious, waterproof covering and does not allow the cambium to be dried out or to be washed by external moisture. The air in the bark cells being in a still condition is a non-conductor of heat, and layer of bark overlying layer, the cambium is completely covered with a dead-air blanket. This keeps it from being frozen in winter and from being over-heated in summer, just as a dead-air space in the walls of a building protects from extremes of heat and cold. From this it appears how careful nature is with the delicate parts of the tree. Should we not then in all our operations of pruning exercise a similar care? It is pitiful to see a good orchard turned over to the tender mercies of the hired man or to the itinerant pruner or tree-butcher. An orchard should always receive the best care of its owner or of some careful man who understands the nature of trees.

The Wood.—The light-colored portion of the wood of the stem, Figure 4, is the sap-wood. It is through this that the sap containing its dissolved mineral elements, finds its way up to the leaves. For its easy and rapid passage the sap-wood has hair-like tubes or vessels. These are formed from the cambium, larger ones in the spring when the tree is carrying a large amount of sap, and smaller ones in the fall when its energies are slowing down. It is this difference in the size of the sap vessels that makes what is called the grain of wood. In the leaf the watery portion of the sap is evaporated and the residue under the action of light is combined with the carbon dioxide or carbonic acid gas of the air. This makes the manufactured food of the tree. It now returns down the cambium layer, towards the root passing from cell to cell and being absorbed as the tissues require. The dark central portion of the stem is the heart-wood. This was once sap-wood, but after working for some years the vessels have become clogged up and now take no part in the circulation of the tree. The heart-wood is practically dead wood and therefore has nothing to do with the activities of

growth but simply gives the tree support. After a few years, too, the first-formed layers of bark die and accumulate on the outside as dead protective tissue. Gradually the expanding of the growing wood within causes it to flake off. It is due to the very large proportion of heart-wood to sap-wood in old trees, thus reducing the living wood to a minimum, that they bear fruit of diminished size. This is well illustrated in aged peach trees, where the terminal growth becomes very short and weak and bears only inferior fruit. A severe heading-back causes an abundant growth of new shoots and restores the tree to almost its pristine vigor and productiveness. See Fig. 21.

The Root.—The root when cut across presents the same appearance as the stem and may, for present purposes, be considered as simply a branched extension of the stem, underground. The cambium of the stem is continuous with that of the root and is covered and protected with bark except at the growing points. This covering of bark being, as was said before, impervious to moisture, requires that all water absorbed by the plant be taken in at the root tips. In order to facilitate the easy and speedy passage of moisture into the plant the small roots are supplied with innumerable, small, hair-like bodies known as root-hairs.

Root-Hairs.—Root-hairs may best be seen on some seedling plant, yet every plant and tree has them in thousands. Like the cambium they are so delicate that drying for a few minutes will kill them. It is the destruction of the root-hairs that makes successful transplanting of trees so difficult. If trees could be taken up and planted again without the loss of root-hairs they would never know that they had been moved. This, however, is practically impossible except with the smallest seedling trees; yet, it shows that too great care cannot be exercised in protecting the roots of trees during transplanting. It is owing to the heavy loss of fibrous roots with their root-hairs that makes it so difficult, nay almost impossible, to transplant large trees. Most of the smaller roots with their absorbing root-hairs are cut away and the large roots on account of their many thicknesses of dead bark have little power of producing the hairs. The tree is, therefore, deprived of its organs of absorption and is incapable of

taking plant food from the soil. The leaves on coming out evaporate the sap from the tree and it dries out and dies.

CARE OF TREES IN TRANSPLANTING.

Pruning for Transplanting.—The knowledge of the nature and function of root-hairs shows us how to properly prune the roots of trees. Since countless root-hairs are lost in cutting off large roots in digging trees, it is a good practice to cut the larger roots with a spade the fall previous to taking up. This causes the tree to send out nearer the trunk a strong growth of fine roots which will be taken up with the tree when it is dug. Of course in handling trees the roots should be exposed as little as possible. When nursery stock comes shipped from a distance there is often considerable drying of the roots and many that are broken or barked in packing. All dried and dead roots should be cut back with a knife till living tissue is exposed. The cuts should be made as cleanly and smoothly as possible and all broken and torn roots removed, so as not to become starting points for disease. When the clean-cut, living ends are exposed to the moist soil they quickly callus over and give out new roots. In like manner the rooting of layers can be hastened by cutting away the bark on one side and exposing the cambium to the soil so that a callus is formed. In transplanting a tree it is better to shorten back the roots rather than to leave them long. Figs. 5 and 6 show the roots of a tree before and after pruning for setting. The one pruned will, in a year or so, have a better root development than if planted unpruned as in Fig. 5. After the tree is set the top should be cut back proportionately with the root. Any weakly, slender branches should be removed and be cut closely leaving no stub. Then the other branches can be headed back. In thus observing a due proportion between top and root the leaves on coming out will not be able to give off moisture faster than the roots can supply it. The lack of cutting back the top of the tree in transplanting causes the drying out and death of many trees that might otherwise live.

FORMING THE YOUNG TREE.

When the young tree has become established its formation for future usefulness should begin. During its early years a young tree should be allowed to bear a large amount of foliage. The more leaves it has, the more wood it is able to form and the quicker it comes to maturity. If the tree is quite young and whip-like its side buds should be allowed to produce leaves all the way up the stem. This will cause it to thicken up and become stout and stalky. If the tree is old enough to have a good stout stem the side shoots may be removed and the energy of the tree directed towards the formation of the head. From the trainer's standpoint, this is the most important time in the whole life history of the tree. If handled rightly at this point the tree may become useful, long-lived and productive, but from wrong treatment it becomes broken down and diseased and throughout its limited existence will always be an eyesore as well as a loss to its owner.

The Height of the Head.—One of the important considerations in the training of a tree is the height of starting the head. If trees are headed too low, cultivation about them is difficult and sometimes almost impossible; and without cultivation the best results in orcharding are not to be obtained. The trees too are apt to be injured and their limbs barked by the hames of the horses. On the other hand if trees are headed too high, it is expensive to gather the fruit and the long trunks are very liable to become sunscalded. The trees too are exposed more to wind and a large proportion of the fruit becomes windfalls. It must be understood that at whatever height the head of a tree is started, at that height it will always remain. If for example a limb be started at five feet from the ground and that limb is living twenty years after, it will be just five feet from the ground. The trunk after being once formed does not stretch up, its growth is then only in thickness. All the growth in length is made at the growing points or terminal buds. Young trees are sometimes started too low with the idea that when at bearing age they will be up to the proper height. With such trees it becomes necessary when mature to trim them up and the main branches are made to serve the

purpose of trunk, thus making more surface exposed to the sun than if started high before. Three and one-half to four feet from the ground is a very good height and the limbs should be started from the trunk so as to sufficiently shade it from the sun. Spreading varieties such as Burbank plums should be started higher up because they have a tendency to droop. Upright growers such as Kieffer pears may be started lower, for the erect branches do not impede cultivation operations.

The Number of Main Branches.—Trees should not be started with too many main limbs as afterwards they thicken up and crowd each other and make it necessary to cut out very large limbs. This leaves very large wounds which seldom heal over and usually cause the trunk of the tree to decay and become hollow. As nearly all the food of the tree is made by the leaves the removal of a large limb with a great deal of foliage is a blow struck at the vitality of the tree. The cutting of large limbs is always a damage to a tree and should never be practiced except in the most extreme cases. If a tree has five main limbs and two are cut out there is only three-fifths of a tree left. Moreover the tree is starved till the normal foliage is again restored. Three or at most four main limbs are enough for any fruit tree and if properly placed on the trunk it will never be necessary to cut out a large limb. All the main limbs should not start out at the same height on the trunk for all the weight of limbs and of fruit being directed to a single point the tree is liable to become split down by the wind. A tree having a split trunk or large torn wound is practically ruined and should give place to a new tree. See Fig. 7. For this reason opposite crotches should be avoided, particularly with the brittle wood of the stone fruits. As far as possible have each main limb so started that it has the purchase of the whole trunk opposite it.

ARRANGEMENT OF BUDS.

If we take the tree when it is young and whip-like, we can get any form of head we desire. Fig. 8 at 1, 2, 3 and 4 shows the natural arrangement of the buds in the apple, pear, plum and peach. At 9 is shown a diagnamatic representation of the same. It will be

seen by following the course of the line that the buds have a spiral arrangement, the sixth bud being directly over the first and two turns having been made round the stem in that distance. It is evident from this that by choosing buds we can have the limbs of the tree placed in any position we wish. With trees of drooping habit the leader may be prolonged so as to form an extension top.

PRUNING FOR WOOD GROWTH.

The pruning of the tree before it comes to bearing age is for the purpose of properly forming the tree itself. In other words the treatment is to stimulate the production of wood rather than fruit. As has been said, the young tree should carry a maximum of foliage. Only such limbs should be removed as are misplaced. When limbs cross and rub one another one should be cut out. One limb should not be allowed to grow over another too closely in a parallel direction so as to shade the lower. Care should be taken to see that all suckers are removed so that the air and sunlight have access to the center of the tree.

IDEAL PRUNING.

The ideal pruning consists in removing not branches but buds; not in checking growth but in directing it. It is easier and also less shock to the tree to pinch off buds here and there than a few years later to saw off large, misplaced limbs. From the sap is manufactured both wood and fruit, it is better, therefore, to direct the energy of the mature tree towards growing fruit which goes to the cellar and market than in making wood which goes to the brush pile. It is largely a question of the proper direction of the energies of the tree. Trees should be so formed and shaped when young that in later years pruning should be only slight, and it would never be necessary to cut out large limbs.

PRUNING FOR FRUIT.

This is the pruning of the mature tree. But why do trees produce fruit? It is certainly not for our bene-

fit. They are simply following the natural law of reproducing their own species. A weed or any plant does the same thing, but unlike the weed the fruit of our trees is useful to us and so we stimulate the habit of fruit production. But the tree simply bears the large luscious fruit for the seeds it contains, the beauty and flavor of the fruit making it attractive to animals which assist in disseminating the seeds. If the fruit contains no fertilized seeds the plant casts it off and will not carry it to maturity. The blossom must give the tree more than a promise of seed production or it is cast off before it ever becomes a fruit. Besides the reproduction by seeds, trees are able to reproduce themselves by buds. Every bud on a tree if placed under proper conditions, as is done in the practice of grafting and budding is capable of producing a tree like the one from which it was taken. Under natural conditions the willows along the canals drop off a few buds with a small twig to hold them in place and soon a new willow shrub is formed. If a tree is growing a great deal of wood it is not producing much fruit, and if yielding much fruit is not making much wood growth.

FRUIT SPURS.

It will easily be noticed, by even the most unobservant that all the buds on any tree are not all alike. When the growth starts in the spring some produce only leaves while others produce leaves and flowers in addition. The latter, which contain flowers in addition to leaves, are usually larger, rounder and plumper in appearance as at 4 on the right twig in Fig. 10, while the leaf buds are narrow and more pointed as illustrated in all the other buds in Fig. 10. Many leaf buds are also shown in Fig. 8. It will be noticed too that the leaf buds are most numerous along the side and towards the tips of the terminal branches, and the flower or fruit buds are found mostly on short spur-like branches throughout the tree. These short spur-like branches are commonly called fruit spurs. Since the fruit spurs are the branches on which the fruit is actually borne it is necessary that we be fully acquainted with their nature and growth in order to give them the treatment they require. Fig. 10 shows a fruit spur

from a pear tree. It will be noticed first that this spur is very irregular and crooked in growth. This is due to the fact that whenever fruit is borne it terminates the spur, and to continue its growth the spur must grow on from a side bud. In this spur fruit was borne at 1 and the growth terminated there. But while the fruit was being developed a leaf bud was formed on each side of it, and next spring grew out to form the first fork. Similar changes in the direction of the growth are also seen at 2, 3, 3, 3, and 4, 4, 4.

When a bud develops during the summer and matures in the fall for passing the winter it covers over the tender growing point with many protecting scales. These scales are crowded closely together so that their bases form a complete ring beneath the bud and their edges overlap covering the tender parts entirely. When winter is passed the bud scales are of no further use and as growth starts and the bud expands they are forced apart and drop off. However, the ring their bases formed beneath the bud leaves its impression deeply fixed on the bark. Such rings are seen on the twigs in Fig. 10 at a. b. c. d. e. f. g. and h. Since the bud scales are the parts last formed in the fall, they mark the termination of each season's growth. From them we can tell the age of the twig. For example the ring h marks the termination of the growth in the fall of 1901, all the part above it growing during the season of 1902. Ring g then marks the termination of growth in the fall of 1900. Counting the rings to *a* we see that the spur is eight years old. From its appearance we can read the life history of the fruit spur and see what it has been doing during these eight years. In the fall of 1894 the ring showed that the growth terminated in a leaf bud at a. In the season of 1895 it grew straight on and matured a fruit bud at b. In 1896 this fruit-bud blossomed and produced a pear at 1; and since the pear grew right on the end of the twig it terminated the branch. But while the pear was ripening, a little bud formed on each side of it at c, c. Since the pear required a great deal of nourishment to mature it the buds c, c did not get food enough to form full, plump fruit buds, but became narrower leaf buds. Each of these grew on in 1897 to d, d. But this year there was no fruit to raise and so the bud d on the right got more plant food and was able to become a full plump fruit

bud. The one on the left however made a feeble growth and again ripened a leaf bud at e. In 1898 the right bud d produced a large fruit as shown by the thick twig and terminal scar at 2. While this fruit was ripening a leaf bud was being formed on either side of it at e, e. The year 1899 was a very favorable season and the twigs made a considerable growth to f, f, and each ripened strong fruit buds. Even the feeble left-hand twig was able to ripen a fruit bud at f. In 1900 all the buds flowered and produced fruit at 3, 3, 3. Then in 1901 again followed a year of leaf buds. The final year the left and center twigs bore again but the one on the right changed its bearing year and would have borne in 1903.

From the history of this fruit spur we see that it has in the year 1902, 1900, 1898, 1896 borne fruit, and in 1901, 1899, 1897, 1895 borne leaf buds. That is, it has had fruit only every alternate year. The reason for the off years with trees will now be evident. In looking carefully at the cross-section of the trunk of an apple tree, shown in Fig. 4, it will be seen that after the tree came to its tenth year it shows wide and narrow rings of wood alternately. A narrow ring of wood represents a year in which the tree bore fruit and consequently did not make much wood growth. The alternate wide rings represent the off years when the tree had no fruit to mature and so directed its energies towards wood growth. If for any reason the blossoms fall off or the fruit is not carried to maturity there may be food enough to form fruit buds for next year, and so change the bearing year of the tree. An example of this has already been shown at 4 in the twig on the right. The crooks in the spurs indicate in every case when the fruit was produced, and the size of the scar and the thickening of the twig show whether the fruit came to maturity or not. From the number and the appearance of the fruit spurs in a tree it is easy to tell whether the tree has been fruitful or not. The tree in Fig. 1 showing a large number of short crooked spurs may easily be recognized as a good bearer, while the tree in Fig. 2, having no fruit spurs but many suckers, is an unproductive tree. The former is busy bearing fruit and consequently is making little growth in length. The latter is making a great wood growth and is trying to reproduce itself by buds and so pro-

duces no fruit. The two methods of reproduction by wood and by fruit stand in a sort of counterpoise to each other. Anything that acts as a check to one stimulates the other. The skill of the pruner is required to maintain the proper balance between the reproduction by growth and by fruit. If one kind of reproduction is getting too much the start of the other, it is necessary to check the predominant one. If trees are pruned in the growing period, growth will be checked and fruiting stimulated. Since a certain amount of wood is removed the remaining buds get an increased supply of nourishment and leaf buds are developed into fruit buds. This pruning in summer should be confined mostly to heading back the too fast growing branches. If on the other hand the center of the tree is much thinned out many of the fruit-bearing branches are removed and the energies of the tree are still further directed towards wood growth. The growth of the tree might also be checked and fruit buds developed by sowing the orchard to some cover crop after the middle of the summer. Withholding of water would serve the same purpose, or the plow might be made to run a little deeper so as to cut off some of the surface-feeding roots and root prune the tree.

TIME TO PRUNE.

The time when pruning should be done is determined by the purpose such pruning is intended to serve and by the healing of the wounds. Pruning of trees to encourage fruitfulness as has just been said should be done in summer when the trees are in active growth, preferably in June or July. Pruning for wood growth on the other hand should be done when the trees are dormant. The best time is in the spring before the buds start. Pruning should not be done in winter time and never in frosty weather. When a wound is made in winter the delicate cambium is exposed to rough winds and low temperatures and is killed back for some distance between the bark and the wood. Every day of zero weather increases the trouble and in spring when growth starts instead of the cambium starting at the cut to heal over the wound it has to start considerably below to grow up the part that has been killed back. Frost-bitten wounds are slow to

heal. The most rapid healing growth is made just as the sap is starting into active movement in the spring. Wounds made at this time will heal quicker than at any other time of the year.

HEALING OF WOUNDS.

Limbs to be removed should be cut off with a sharp saw, as smoothly as possible, and as close to the main stem as possible. There should never be any stub left, for the cambium being unable to grow over the stub it is left to decay, which it does in a few years, leaving a hole. This usually causes the trunk to become hollow. A tree with a hollow trunk is practically ruined. Often where a limb joins the trunk or another limb, there is a thickening or shoulder of woody tissue. In cutting outside of the shoulder a smaller wound may be made in cutting off such a limb, but if by so doing a stub is left it is better to cut through the shoulder even though a larger wound is made. This is contrary to the practice of many pruners who seem to think there is some special healing virtue at this shoulder. The shoulder however differs in no way from other woody tissue of the tree, but is merely due to the thickening of the wood to support the weight of the limb. Thickenings of wood for similar purpose may be seen at the collar of the tree and often in fruiting twigs which bear heavy fruits. Fig. 11 shows an example of such twigs taken from a Ben Davis apple tree. Wherever in a plant there is any special weight to be carried nature always thickens the tissue to bear the strain. Limbs should in all cases be cut as closely as possible so as to leave no stubs. Fig. 18 shows where a rapid healing growth is the result of a closely-made cut. The lower part of the figure shows a completely healed wound. Unless there are buds on the stub the sap will cease to flow into it and its healing over is impossible. The most rapid healing takes place where a wound is made close to the trunk and gets the flow of food material as it passes downward from the leaves. The farther away a wound is from the downward passage of food material the slower it heals. A sucker growing at a wound will cause it to heal over quicker than if there were no sucker, for wherever leaves are, food is being formed and wood material is

being deposited. The sucker had better be removed the second year. It goes without saying that a limb should be removed with as little possible injury to the remaining parts. Torn wounds never heal well and often cause the death of the tree. It is not necessary to smooth off cut surfaces with a knife if the cut is made with a good sharp saw. If large limbs are to be removed, which should never happen if trees are started rightly, there is a danger of the weight of the limb tearing down the bark. To avoid this cut from below first and meet this cut with one from above, or if this cannot be done cut off the limb a foot from the tree and then remove the stub.

Painting and Dressing of Wounds.—Wounds larger than an inch across should have some waterproof dressing to exclude rain and preserve the wood till healed over. Some people have the impression that painting or dressing a wound retards the healing process. Since the wound is not healed over by the old wood but by the cambium growing over from its edges this cannot be the case. Small wounds usually heal in a year or two and cause no trouble, but if a cut surface lies exposed for some years to sun and rain it generally becomes the home of wood-destroying fungi and is decayed before completely healed over. It is evident that any dressing that tends to keep the wood sound and healthy till healed over is of benefit. Any dressing that will exclude moisture will be effectual. Thick paint of lead and raw linseed oil is about the best dressing that can be recommended. In spraying the orchard with Bordeaux mixture always spray cut surfaces as the mixture kills wood-destroying fungi and preserves the cut surfaces.

Pruning Tools.—The best pruning tools are those with which the branch can be removed quickly and with the least possible injury to the remaining tissue. For hardwood trees a fine-toothed saw is the tool best answering these requirements. It should be sharp and set widely so as to clear itself and work easily without pinching. A narrow bladed saw as in 4 Fig. 15 with a clamp and set-screw to hold it rigid is one of the cleanest cutting and most rapid tools. This mounted on a pole can be easily operated from the ground and saves much time and labor in climbing into the trees. The saws 3 and 5 are rapid cutting tools but having wide

blades they often trouble by gumming up and wedging in the wood. The hooked knife Fig. 7 is always a handy tool for light work. The hand shears Fig. 6 are very convenient for small limbs and soft wooded plants such as small fruits. Pruning shears of the long handled powerful type as Fig. 2 should not be used on hard-wood trees as they pinch the bark and crush the delicate cambium, and a badly-healing wound is the result. Shears of this kind are very useful with the bush fruits, particularly with those that are thorny. The hedge shears Fig. 1 are very convenient for the heading back of the herbaceous shoots of bush fruits. Fig. 8 is a very handy tool for heading back long branches which are difficult to reach. This form of tool is much used in the pruning of shade and ornamental trees.

Care in Trimming and Handling Trees.—It will be evident from what has already been said concerning the working parts of trees, that they are made up of very delicate tissues. Trees are very susceptible to good treatment and respond readily to it and on the other hand are just as easily injured. Few people who work with and about trees have any idea as to the care they should receive. Probably more than half the trees raised in this country are spoiled by careless and ignorant handling in their life from nursery to bearing age. Starting with the nursery they are too often allowed to produce badly-formed tops before setting out. Too often they are carelessly packed into boxes and the branches and roots unnecessarily broken or barked. Too many trees die or are impaired in vigor by exposure at the time of transplanting. Too many trees are needlessly barked with the whiffle-trees during cultivation. A scarred trunk is more than an eyesore, it is a money loser. Too many trees are spoiled by the top being wrongly started. Too many trees are ruined by being too heavily pruned.

It is better to err in pruning trees too little than in cutting too heavily and taking out a large amount of wood. A heavy pruning is always followed by a heavy growth of suckers. Almost any orchard will show trees injured in one or more of these ways. Even more trifling causes stamp their scars and blemishes. A ladder thrust carelessly into a tree at picking time very often leaves its mark. Some men can hardly pick

a tree without leaving more or less of broken and twisted limbs. The careless use of the pruning saw and shears is often seen in torn bark and lacerated wounds. The crotches about the trees give evidence that the pruner wore hobnailed boots. Even the favorite sweet apple tree near the house that children frequent, shows the marks of the little boot-heels on its limbs. The more one has to do with trees the more one is convinced that they are made up of delicate, easily-injured parts and should accordingly receive only the most careful treatment. In pruning trees the operator should wear rubbers or smooth-heeled boots, so that when getting about the trees the bark is not injured. The best nurserymen always require that their employees in packing trees should wear rubber boots.

Wrong Practices.—In addition to the foregoing there are some practices such as sliting bark, boring holes, or driving nails into trees, that are to be discouraged entirely. The bark of trees is sometimes slit down with a knife because they grow slowly or are said to be "hide bound." The reason the trees grow slowly is because the ground lacks manure and cultivation and not because of any special tightness of the bark. The sliting only causes the trunk to grow a ridge down that side to repair the injury. When the trunk gets large the ridge usually splits down and leaves a dead surface for its entire length. There is a natural pressure of the bark on the wood in any tree but nature provides for the gradual giving away of the bark to suit the growth of the trunk. If by sliting or any other means the pressure is relieved at any part, all growth takes place at that part and a ridged trunk is formed. Nature provides for all expansion of the trunk. It is only necessary for us to manure and cultivate the tree to keep it growing vigorously. Boring holes in the trunks of trees is entirely unnatural and is very harmful. Insects or fungous diseases can never be combated by putting anything in holes bored into the trunks of trees. The driving of nails or spikes into trees for any purpose whatever is always harmful.

Pruning a Neglected Orchard.—With the general farmer who is not making a speciality of fruit growing the orchard is often much neglected. If there is a favorable season and promise of fruit the trees may

receive a more or less heavy application of the saw, but usually they remain for years without any attempt at either pruning or cultivation. Too often the orchard is an enclosure for stock and its pruning left entirely to their charge. And the stock never fail to prune the trees, too, but such pruning can hardly be said to conduce to the health and fruitfulness of the orchard. Unpruned and uncultivated orchards never direct their energies in the direction of large crops of fine fruit. They are generally found to be so choked with branches that fruit production is practically impossible. Fig. 20 shows a tree in this condition. The question often arises, can a neglected orchard be made productive again and how would one go to work to remodel it. The reason such an orchard did not bear is because it had gone too much to wood growth. Consequently to get it to bear, the wood growth must be checked and fruiting stimulated. The common practice is to seek to accomplish this by a single heavy pruning, leaving the ground about the trees literally covered with brush. But heavy pruning conduces to wood growth and a heavy growth of suckers invariably follows. At the same time the loss of a large amount of foliage strikes at the vitality of the tree. The proper method of treatment is to prune moderately taking out all dead limbs and a few of the worst offending branches, and letting light and air into the tree. The second season some more may be taken out, and the suckers from the first year's pruning removed. The third season the trees may be brought into proper condition. By this gradual pruning the trees are not shocked so as to kill them nor is their vitality impaired.

Pruning Old Trees.—It will be noticed that old trees nearly always have small fruit. This is due to the fact that the twigs become enfeebled and make very little new growth. They have been working for so long that their sap-wood has become plugged up and changed to heart-wood just as in the trunk of a tree. In other words the circulation has become sluggish and the fruit not getting the nourishment it requires does not develop fully. If, however, a new shoot grows up from any of the limbs and bears fruit, it will be large well-developed fruit because grown on fresh active wood. Old trees may be renewed by being closely pruned back so that they throw up a number of new shoots.

These if properly placed may take the place of the old inefficient limbs and the tree is rejuvenated. Old orchards may be kept productive for many years by close pruning of the old wood.

Pruning the Pear.—Since the pear tree bears its fruit on spurs like the apple tree it will be pruned in much the same manner as the latter. However, pear trees have characteristics differing from the apple that require special treatment. One peculiarity of many varieties of pears, particularly when young, is to send up long erect shoots. If unchecked, this causes the tree to become very tall and narrow like a Lombardy poplar. Every spring about half of the growth of the long erect shoots should be cut back. The cut should be made close above a bud and that bud should be facing from the center of the tree. This causes the new growth to be directed from the center of the tree. Fig. 19 shows the head of a young tree started in this way. Half of the resulting shoot being again cut to an outside bud will give the tree a second spread. In this way the growth of the tree may be directed to a proper form and the whole made low, short-jointed and productive. This heading back of course stimulates the production of fruit spurs within the tree.

Fruit Spurs of Plum and Cherry.—The fruit of the plum and cherry is also borne on spurs, but different from those of the apple and pear. While in the latter the fruit terminates the spur and causes the growth to go off side ways, in these there is always a leaf bud at the end of the spur. This makes the fruit spur of the plum and cherry straight, so that the rules for detecting fruitfulness in the apple and pear will not answer for the plum and cherry. Fig. 13 shows a fruit spur of the cherry and Fig. 14 one of the plum. In Fig. 13 the rings at a. b. and c. show that the spur is three years old. The scars between show where the cherries were borne. Each year the terminal leaf bud extends the spur straight ahead and the fruit buds are clustered closely behind it. Fig. 14 shows the same method of growth of the terminal leaf bud. At the base of the spur will be seen the stems of last year's fruit, while up the shoot are the fruit buds for this year. The fruit buds of the plum are narrow and pointed and do not show the plump appearance of those in other fruits. It is well known, too, that plums and cherries usually

bear annually, and do not follow the alternate habit of the apple and pear. Since the wood growth, or the hoots from the leaf buds tend to give place for the placing of fruit buds, the wood growth and fruit growth in plum, and cherries go hand in hand and are not opposed to each other as in apples and pears. In plums and cherries what tends to wood growth tends also towards the production of fruit buds. Heading-in pruning in these latter fruits is, therefore, not resorted to with the mature tree as with the apple and pear.

Pruning the Plum —Plum trees vary considerably in habit of growth. Some varieties, for example the Wickson, have a very erect habit of growth and need to be headed back to an outside bud each year while young. Other varieties such as the Burbank are of very drooping habit and must be pruned to an inside bud to keep them from sprawling down over the ground. Young plum trees should be headed back each year to make the wood short-jointed, and to keep the tree in proper shape. This heading-back pruning can be very readily done from a platform built on a wagon. The wagon may be driven from tree to tree, thus saving the trouble of shifting ladders and going up and down. The best tools for heading back are shears like 2 and 6 in Fig. 15.

Pruning Cherries.—After being once started rightly cherries require scarcely any pruning whatever. They have naturally an even habit of growth that makes a nicely formed tree, and the fruit growth keeping pace with the wood growth there is no necessity for any stimulative pruning. An occasional sucker or dead limb taken out is about all the pruning they ever require. Sour cherries often produce a great profusion of fruiting twigs and may sometimes need a little thinning, but if given plenty of manure they will generally take care of themselves and bear all the fruit they set.

Pruning of the Peach.—The peach tree bears its fruit on the new shoots of last year's growth. There is, therefore, no development of fruit spur as in the apple, pear, and plum. The fruit buds are borne on the new terminal wood along with the leaf buds. In Fig. 12 showing a peach twig, the small thin buds marked 1 will readily be seen to be leaf buds. The plump outer buds in the clusters of three are the fruit buds. The central bud of the three is a leaf bud and

like other leaf buds bears no fruit but is capable of developing a twig or branch. The fruit buds of the peach bear no leaves and are incapable of continuing the growth. One peculiarity of the peach tree is that it is intolerant of its own shade and early loses its leaves and growing branches in the center of the tree. Old trees have leaves and fruiting branches only on outer and terminal parts. This condition may be avoided by giving the trees when young an annual heading-back of one-fourth or one-half of the new wood each year. This causes new growth to be thrown out all through the tree and more and better fruiting wood is produced. Since the fruit buds are on the last year's shoots it is evident that heading-back acts in the direction of thinning the fruit. By observing the number and position of the triple buds on the shoot the pruner can tell just how much heading back he should do. When peach trees become old they will have, if they have not been regularly headed in, very short, slender terminal wood capable of bearing only inferior fruit. Fig. 21 shows a tree in this condition. Though the trunk and root are in good healthy condition the tree is practically worthless for lack of young, fruiting wood. Its only salvation is to be cut back leaving only the stubs of the main limbs. Fig. 16 shows an aged peach tree one year after being so cut back. It has an abundance of young fruiting wood which is liberally supplied with fruit buds. All that is now necessary is to thin out the weaker branches and let the stronger ones bear fruit. Fig. 17 is the same tree pruned for fruiting.

Pruning Red Raspberries.—The wood of raspberries is biennial. It grows up the first year from the root as long shoots or canes. In the fall the canes ripen for passing the winter. If headed back during the summer the canes force their buds and produce lateral branches. The following year fruit is produced from the shoots arising from the buds of the main cane or from the buds of the laterals. After fruiting the canes die. The root, however, is perennial and with good cultivation will produce new canes indefinitely. Raspberries may be pruned in autumn as soon as the falling of the leaves shows that the wood is ripe. Autumn pruning is always preferable where the canes have been attacked by borers or by fungous diseases. The removal and burning of the affected canes keeps

the insects and fungous spores from being carried over to the next season. On good healthy plantations, however, pruning is generally done in the spring. This requires but once going over the plantation and then there is the added advantage that any canes that have been winter-killed or broken down by snow may be removed without a second pruning. When done in either spring or fall the practice is to

(1) Take out all dead canes, cutting them off close at the ground;

(2) Take out all injured, diseased, or spindly canes, and those which are out of the row;

(3) Thin out the remaining canes to about 8 inches to 10 inches apart;

(4) Head back to an even height as in a hedge. The height of heading-back will vary from 1½ to 3 feet, depending on the height and vigor of the variety.

There has been a great deal of discussion by horticulturists as to whether raspberries should be pruned in the summer. Summer-pruning causes a great growth of suckers from the roots particularly if the soil is rich, yet if the canes are not headed back they make no side branches. With low-growing varieties such as Marlboro' summer-pruning is not necessary but with high varieties such as Cuthbert it is preferable as the canes are apt to become very tall and spindly; and in order to head them down to proper height the strongest fruit buds are removed. This heading-back should be done when the new canes get to the height of the old, by simply pinching off the herbaceous tops with the thumb and finger. On large plantations this pruning can be conveniently done with hedge shears as in 1 Fig. 15. Figs. 22 and 23 show a section of raspberry row before and after pruning.

Pruning Black Raspberries or Black Caps.—Like the red raspberry the black cap has biennial wood and renews its canes from a perennial root. However, the black cap does not increase from suckers or stolons but remains as a hill or stool plant, and propagates itself by rooting at the branch tips. It always requires summer-pruning to make the plants stout and stalky, and to keep them from being blown over by the wind. The young canes should be tipped when they are a foot and one-half or two feet in height. They will then throw out strong lateral branches, and make stout

vigorous canes. They should never be allowed to get tall before tipping or the best buds will have to be taken off in cutting them back, and the laterals formed in spring will be few and weakly. It will be found necessary to go over the plantation two or three times to nip off the young canes as they get to the proper height. The laterals should be allowed to grow at will throughout the season. As soon as the fruit is harvested and the bushes have begun to shed their leaves, they should be thoroughly pruned. Fall-pruning is imperative with the black raspberry on account of its susceptibility to anthracnose.

The practice is as follows:

(1) Cut out all canes that have fruited, taking them off close to the ground.

(2) Cut out all canes that show the purple eruptions of anthracnose. Burn them.

(3) Leave from three to five canes to a hill.

(4) Head back the lateral branches from twelve inches to eighteen inches in length.

Fig. 27 shows a black raspberry bush properly pruned.

Pruning Blackberries.– The blackberry resembles the red raspberry in habit of growth and requires much the same pruning. Summer-pruning is essential. The canes should be nipped off when they come to the height of 2½ or 3 feet. This makes them stout and forces the laterals on which the fruit will be borne. The laterals are not headed back until the following spring, then they are shortened to one or one and one-half feet in length. Care must be taken to notice whether the fruit buds are produced near the main cane or farther out on the laterals and the heading-back of the laterals will follow accordingly. Too close pruning of some varieties will very materially lessen the crop.

Pruning Dewberries.—The dewberry is closely related to the blackberry but is of trailing instead of erect habit of growth. It is probably for this reason that the dewberry does better in the strong sunlight of the arid region than the high blackberries. While the blackberry propagates by suckers the dewberry increases by rooting at the tips. In looking at a dewberry plantation it is difficult to know how to prune the plant, for it has not been domesticated long enough to respond fully to ordinary garden methods. Many

growers never attempt the riddle at all, but leave the vine to follow its own truant habits. In a year or so the rows become very much choked with dead and surplus wood and the fruit becomes small. About all the pruning that can be given is to remove the bearing vines after fruiting and cut back the too rampant shoots. Dewberries should not be pruned in summer.

Pruning Currants and Gooseberries.—Gooseberries and currants are closely related botanically and are very much alike in habit of growth. They bear fruit on wood that is one year old and older. One-year-old branches bear the largest berries, but branches will continue to bear for five or six years or more. After the fourth year, however, it will be found that the fruit is not so large and fine. Old canes often become attacked by the currant borer and by wood-destroying fungi and are therefore better to be removed before they become diseased and unproductive.

Currant and gooseberry bushes are too often neglected and receive no pruning whatever. Under such conditions the bushes become thick with old, unproductive canes and with stunted, poorly-matured, new ones which can bear only inferior fruit. The gooseberry is apt to become even thicker than the currant, and being thorny it is next to impossible to gather the fruit without painful experiences with the thorns. Pruning this class of plants is simply a thinning process to remove old, inefficient branches and to keep up a constant renewal of new, vigorous, productive ones. The removal of branches acts the same as thinning the fruit and results in large fine clusters of berries.

It has been a common practice, particularly with Old Country growers to trim to a single stalk, or tree form. This gives a fine vigorous plant which would produce four or five crops, but if any accident happens to this one stalk or if it becomes attacked with borers or fungi the whole plant is gone without any chance of renewal. The bush method is to leave all the underground buds at the time of starting the bush from the cutting and gives the best results for commerial purposes.

The simplest and best method of pruning currants is the rotation plan. By this the bush has a fixed number of branches from 8 to 16, depending on the productiveness of the soil. If the bush has twelve branches

there will be three one-year-olds, three two-year-olds, three three-year-olds and three four-year-olds. Every spring the bushes are trimmed and the three four-year-old branches cut out and the three most vigorous new branches allowed to come. This method is so simple that anyone can do the work and the bush is always kept up to its full complement of vigorous, fruitful branches. Of course only the erect branches should be left, all side or drooping branches being taken out. This last is particularly applicable to gooseberry bushes for they are apt to overload and trail the fruit on the ground. In humid regions it is usual to head back the tips of the branches, but in arid countries all the foliage is necessary to protect the fruit from being sun-burned. Gooseberries headed back will produce a heavy growth of poorly-ripened shoots.

The black currant is pruned on the same principle as the red. It is a more vigorous grower and requires more room in the row. Figs. 24 and 25 show a neglected currant bush before and after pruning.

Pruning of Shade and Ornamental Trees.—I should not care to close any treatise on pruning without at least a hint or two on the pruning of shade trees, for shade trees generally receive worse treatment in this line than any other class of trees. Trees grown solely for the purpose of shade or ornament should be allowed to follow pretty freely their own natural habits of growth. For example, it is of little use to try to make the weeping willow do other than weep, or the Lombardy poplar grow otherwise than erect. The prominent characteristics of each tree constitute its beauty and these characteristics should be fostered rather than checked. If the nature and habit of any particular variety of tree are displeasing to us we should select some tree that we desire, rather than try by drastic methods to change entirely the natural habits of the tree. In the planting of ornamental trees only the best of the best should be used and all should be discarded that have not clean, straight trunks and symmetrical tops. Care should be taken to see that ornamental trees are not injured in any way to destroy their beauty. In general, shade trees are better with a main central trunk and limbs evenly disposed around it. Such a tree if given sufficient space will develop naturally a symmetrical top. If it is desirable to give

a tree a close round top the leader bud should be nipped at planting time. If the tree has grown with a central trunk for a number of years it is next to impossible to get a nicely-formed, round head by cutting out the large central trunk. The common practice of cutting off the entire head of a tree and leaving only stubs of the main limbs is to be discouraged. Fig. 28 shows a sample of this murderous kind of trimming. Some hardy species such as poplar or boxelder may survive this murderous treatment, yet their natural beauty is lost forever. Such cutting cannot be otherwise than a blow to the life of a tree. The result is always more or less of great, dead stubs that are never healed over, but later rot and leave holes in the trunk of the tree. The great growth of suckers following such cutting is a pathetic evidence of nature's efforts to recover from the blow she has received. The resulting tree, which in summer resembles a hay-cock on a gate-post and in winter a brush-pile on a pole is certainly not a thing of beauty. Shade trees can be too thick with branches as well as too thin; either extreme is to be avoided. The proper pruning for shade trees is a slight heading-back each spring of the most rampant branches, so as to keep the tree in an even symmetrical form. Of course all dead and broken limbs should be removed and also those that droop too low. The beauty of ornamental trees is often spoiled by their being tilted over by the wind or by the top growing heavily toward the leeward side. This defect can be greatly obviated if at planting time the trees are sloped a few degrees toward the direction of the prevailing wind. It will be found in observing the roots of trees that the largest roots generally start from the trunk in opposite directions rather than at right angles. Fig. 26 shows an example of this. These are sometimes known as the brace-roots of the tree. If these brace-roots are placed in a straight line with the direction of the prevailing wind they will anchor the tree and hold it firmly in the ground. If this precaution is neglected and the brace-roots are set at right angles to the prevailing wind the tree is whipped back and forth as if on a hinge.

Evergreen trees should never be pruned for they naturally grow in pyramidal form that cannot well be

improved. The grotesque forms of ornamental pruning seen in some gardens do not at all approach the beauty of nature's own artistic handiwork.

PRUNING MAXIMS.

1. Start the tree right.
2. Do not cut out large limbs.
3. Keep your tools sharp.
4. Never prune in frosty weather.
5. Frost-bitten wounds are slow to heal.
6. Never leave stubs in cutting off limbs.
7. Prune annually but never heavily.
8. Wounds heal most rapidly in spring.
9. Heavy pruning conduces to wood growth.
10. Never use a hatchet for removing suckers.
11. Avoid injuring the cambium in any way.
12. Don't leave your pruning to the hired man.
13. The more you understand trees the better you will prune them.
14. A severe heading-back will renew the tops of old peach trees.
15. In transplanting be careful of the root-hairs.
16. In transplanting cut back top and root.
17. Do not head trees so low as to interfere with cultivation.
18. Drastic pruning strikes at the vitality of the tree.
19. Do not start all main limbs at the same height.
20. Keep the tree free of suckers.
21. Summer pruning induces fruitfulness.
22. Torn wounds are generally fatal.
23. Paint over the larger wounds.
24. Trees are delicate structures and require careful handling.
25. A heavy pruning is always followed by a heavy growth of suckers.
26. Never slit the bark, bore holes, or drive nails into trees.
27. Never allow stock to prune your trees.
28. Unpruned, uncultivated orchards are not money-makers.
29. The orchard is not a profitable source of firewood.

30. Blackberries and black raspberries should always be tipped back in summer.

31. Prune gooseberries and currants by the renewal or rotation system.

32. Do not decapitate shade trees.

33. Never prune evergreens.